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# Noteworthy records and distribution of Peruvian Long-tongued Bat, *Platalina genovensium* Thomas, 1928 (Chiroptera, Phyllostomidae)

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**Abstract**
*Platalina genovensium* is one of the most endangered species of the subfamily Lonchophyllinae, currently known from a few localities on the western slopes of the Andes, and only 1 locality on the eastern side of the Peruvian Andes. Here, we report 9 new localities for this species, including 3 from the eastern slopes, which confirm the oriental distribution. Besides, a potential distribution model further suggests the wider presence of *P. genovensium* on the eastern slope of Peru, from the Marañón River to at least the Huánuco department; and on the western side, the model suggests the species probably occurs in Antofagasta, Chile, but it could also represent a false positive.

**Key words**
Amazonas; Antofagasta; Atacama; Cajamarca; Marañón; potential distribution.

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## Introduction

The Peruvian Long-tongued Bat, *Platalina genovensium* Thomas, 1928, is one of the largest species of the Lonchophyllinae subfamily and the only nectarivorous bat occurring in dry ecosystems from low to high elevations, from near sea level to about 2,300 m a.s.l. (Sahley and Baraybar 1996, Griffiths and Gardner 2008). This species is currently distributed from northern Peru to northern Chile (Velazco et al. 2013, Ossa et al. 2016). At first, several authors suggested that *P. genovensium* was restricted to the central and southern coast of the western Peruvian Andes (Thomas 1928, Tuttle 1970, Jones and Carter 1976), but later, it was reported from Huánuco on the eastern Andes (Sanborn 1936), the northern coast of Peru (Aellen 1965), and the northern coast of Chile (Galaz et al. 1999). Although the distribution of *Platalina* includes several localities on the Peruvian coast, these records come mainly from studies about their preferences for caves and feeding on flowers and fruits of columnar cacti (Sahley and Baraybar 1996, Griffiths and Gardner 2008, Velazco et al. 2013). Recently, Velazco et al. (2013) recorded *P. genovensium* from Piura (Peru) after 40 years and Ossa et al. (2016) from Chile after 17 years. However, *P. genovensium* has not been recorded from the eastern Andes since 1936 (Sanborn 1936), raising the possibility of local extinction.

Due to the few locality records, evidence of small populations, and the destruction of its habitats, *P. genovensium* was listed as Endangered by the Peruvian constitution (Decreto Supremo N° 004-2014-MINAGRI) and as Near Threatened by the International Union for

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Conservation of Nature (Pacheco and Aguirre 2016). In the present study, we aim to update the distribution of *P. genovensium*, presenting new records based on recently collected specimens stored at the Museo de Historia Natural of Universidad Nacional Mayor de San Marcos (MUSM), to build a potential distribution map that could be used for conservation purposes, and to provide some natural history and conservation notes.

## Methods

We examined specimens of *Platalina genovensium* stored at the Museo de Historia Natural of Universidad Nacional Mayor de San Marcos (MUSM). Uncatalogued specimens were identified by field collector codes: MNH for Maggie Noblecilla and DLR for Diana La Rosa. Specimens examined were preserved as dry skins or in alcohol, with the skull removed.

We identified our specimens using the key of Griffiths and Gardner (2008) and morphological descriptions of Thomas (1928) and Phillips (1971), as well as by direct comparisons with other specimens available at MUSM. We took a set of measurements following Mantilla-Meluk and Baker (2010) using a digital caliper.

Additionally, we created a potential distribution map using MaxEnt software (Phillips et al. 2006, Phillips and Dudik 2008) for all localities available in the literature (Baraybar 2004, Velazco et al. 2013) and our new

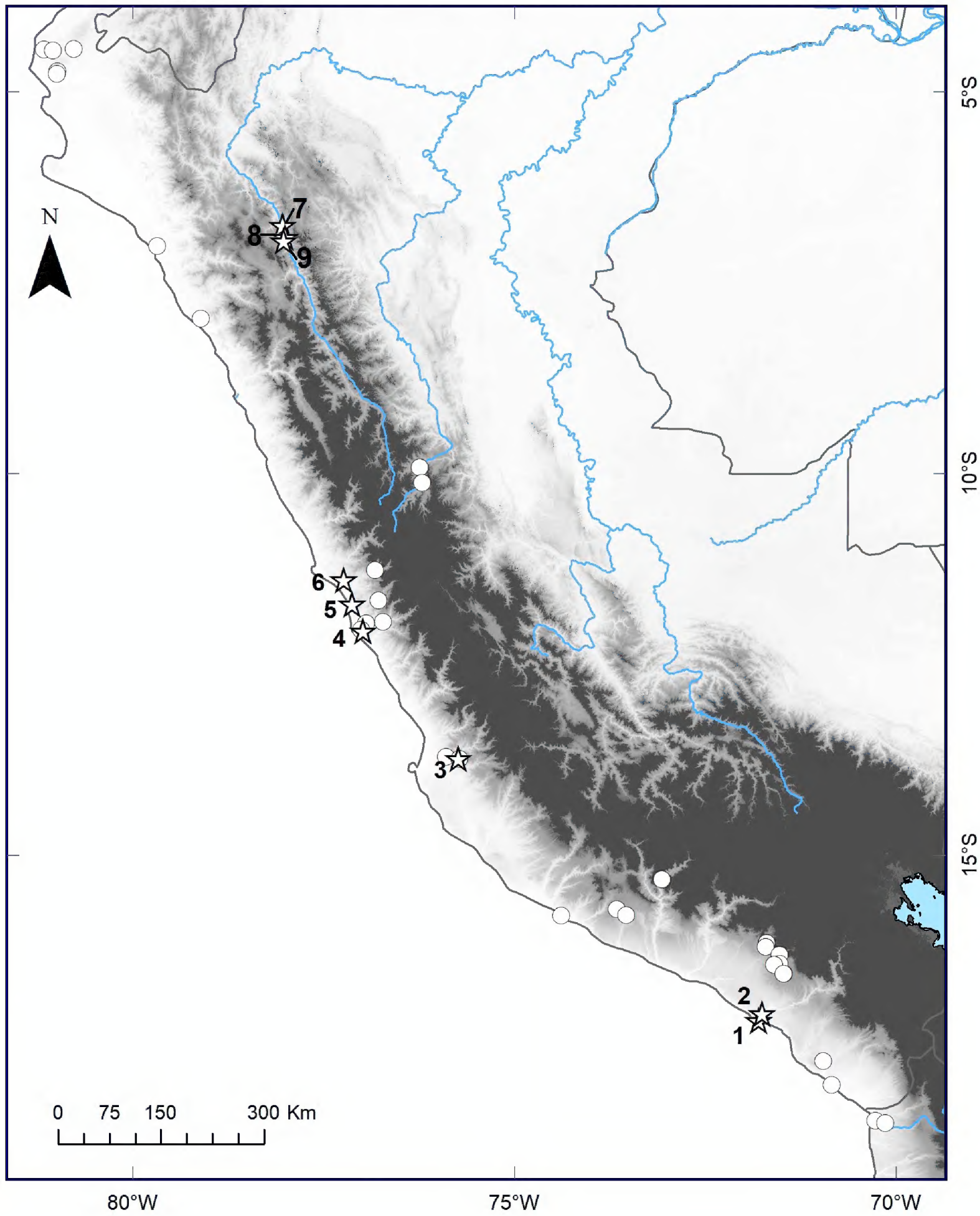


**Figure 1.** Map of records for *Platalina genovensium*: published records (circles) and new records (stars): 1) Punta de Bombón (Arequipa), 2) Cocachacra (Arequipa), 3) near Bolivar mine (Ica), 4) Ate (Lima), 5) Ancón (Lima), 6) Lomas de Granados (Lima), 7) Tuén (Amazonas), 8) Balsas (Amazonas), and 9) Cantange (Cajamarca).

**Figure 2.** Dorsal, ventral and lateral views of the skull and lateral view of the mandible of *Platalina genovensium* from Tuén, Amazonas (left, MUSM 38627) and Balsas, Amazonas (right, MUSM 44631). Scale bar = 10 mm.

records. We used a database in 'CVS' format employing all 19 bioclimatic layers (http://www.worldclim.org) and 3 consensus land-cover layer: shrubs, herbaceous vegetation, and barren (http://www.earthenv.org/landcover). We also included unequivocal records based on direct observations, photos, videos, or acoustic evidence.

## Results

**New records** (Fig. 1)**. (1)** Punta de Bombón, Islay Province, Arequipa Department (17°10′16″ S, 071°47′28″ W; ca 20 m a.s.l.), 1 specimen (DLR 384) collected by D. La Rosa, October 5, 2005. **(2)** Cocachacra, Islay Province, Arequipa Department (17°04′33.30″ S, 01°44′41.76″ W; ca 100 m a.s.l.), 2 specimens (MNH 149, 150) collected by M. Noblecilla, April 29, 2009. **(3)** Bolivar Mine area, Pisco Province, Ica Department (13°43′57″ S, 075°43′38″ W; 1148 m a.s.l.), 1 specimen (MUSM 45502) collected by D. Ruelas, July 03, 2016. **(4)** Ate, Lima Province, Lima Department on November 4, 2017, recorded in video by the security personnel of an office supply depot. **(5)** Ancón, Lima Province, Lima Department (11°42′45″ S, 077°07′26″ W; ca 200 m a.s.l.) by J. Pacheco and S. Grillo, who recorded photos, videos, and vocalizations. **(6)** Lomas de Granados, Huaral Province, Lima Department (11°23′40″ S, 077°13′53″ W; 707 m a.s.l.; and 11°24′36″ S, 077°14′05″ W; 281 m a.s.l.), 1 tissue (MUSM 42352), collected by V. Pacheco on March 24, 2014, and 6 specimens (MUSM 44688–44693: 5 males and 1 female) collected by D. Ruelas, December 7, 2015. **(7)** Tuén, Luya Province, Amazonas Department (06°44′39″ S, 078°02′04″ W; 899 m a.s.l.), 1 specimen (MUSM 38627, Fig. 2) collected by C. Jiménez, March 22, 2011. **(8)** Balsas, Chachapoyas Province, Amazonas Department (06°54′16″ S, 077°59′54″ W; 889 m a.s.l.), 1 specimen (MUSM 44631), collected by A. Aguilar, September 21, 2014. **(9)** Cantange, Celendín Province, Cajamarca Department (06°56′59″ S, 078°01′01″ W; 1163 m a.s.l.), 1 specimen (MUSM 44632, Fig. 2) collected by A. Aguilar, September 21, 2014.

**Identification.** These specimens present diagnostic characters described by Thomas (1928), Phillips (1971), Griffiths and Gardner (2008), and shared by other specimens from MUSM collection (Appendix 1). We present a table of external and craniodental measurements (Table 1). The species is characterized by having 3 upper molars and 3 lower molars (Phillips 1971); however, several anomalies were found. One specimen (MUSM 44689) from Lomas de Granados had only 2 upper molars on each side. Another specimen from Amazonas (MUSM 38627, Fig. 2) had 2 upper molars on each side, 2 lower molars on the right side and 3 on the left side, but the third lower molar is unusually narrow (half the width of the lower molar) and very close to the adjacent molar. Both specimens are male and do not show any scar of dental alveoli that could suggest the third molar is missing. All males recorded in this study have robust mandibular rami, except one specimen from Amazonas (MUSM 44631, Fig. 2) that has an unusually narrow mandible,

**Table 1.** Sex and external and craniodental measurements (in millimeters) of the holotype *Platalina genovensium* (from Thomas 1928) and new records from the eastern Andes. Sex: female (f), male (m).

| Measurements | Holotype | Punta de Bombón | Cocachacra | | Lomas de Granados | | | | | | Near to Bolivar mine | Tuén | Balsas | Celendín |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B.M. | DLR | MNH | MNH | MUSM | MUSM | MUSM | MUSM | MUSM | MUSM | MUSM | MUSM | MUSM | MUSM |
| | 27.11.19.38 | 384 | 149 | 150 | 44688 | 44691 | 44689 | 44690 | 44692 | 44693 | 45502 | 38627 | 44631 | 44632 |
| Sex | m | f | f | f | m | f | m | m | m | m | m | m | m | m |
| Total length | 81.00 | 80.00 | — | 81.00 | 89.00 | 88.00 | 87.00 | 82.00 | 85.00 | 88.00 | 77.00 | 86.00 | 90.00 | 82.00 |
| Tail length | 9.00 | 6.00 | — | — | 9.00 | 9.00 | 8.00 | 10.00 | 9.00 | 8.00 | 10.00 | — | 10.00 | 8.00 |
| Hind foot length | — | 13.00 | 14.00 | 14.00 | 15.00 | 13.00 | 13.00 | 13.00 | 13.00 | 13.00 | 12.00 | 13.00 | 15.00 | 13.00 |
| Ear length | 13.00 | 15.00 | 17.00 | 17.00 | 21.00 | 20.00 | 20.00 | 17.00 | 19.50 | 20.00 | 21.00 | 16.00 | 19.50 | 18.50 |
| Tragus length | — | 8.00 | 8.00 | 8.00 | 8.00 | 7.00 | 9.00 | 7.00 | 7.00 | 8.00 | 9.50 | 8.00 | 10.00 | 9.00 |
| Forearm length | — | — | 50.00 | 51.00 | 51.00 | 50.00 | 48.10 | 47.49 | 48.00 | 49.00 | 48.50 | 51.00 | 50.50 | 49.50 |
| Greatest length of skull | 32.00 | 31.85 | 31.68 | 32.54 | 31.71 | 31.62 | 32.03 | 30.74 | 30.88 | 31.73 | 31.74 | 31.39 | 31.46 | 31.08 |
| Condylobasal length | 31.00 | 30.39 | 30.26 | 30.84 | 30.41 | 30.23 | 30.40 | 29.54 | 29.66 | 30.51 | 30.71 | 29.85 | 30.00 | 29.82 |
| Condylocanine length | — | 29.27 | 29.23 | 29.33 | 29.31 | 29.04 | 29.23 | 28.62 | 28.42 | 29.42 | 29.14 | 29.29 | 29.14 | 28.63 |
| Palatal length | — | 18.57 | 18.11 | 18.53 | 18.06 | 18.08 | 17.81 | 18.00 | 17.65 | 18.10 | 18.24 | 17.44 | 18.27 | 17.30 |
| Postorbital constriction | 5.00 | 5.11 | 4.84 | 5.09 | 5.17 | 4.98 | 5.13 | 4.91 | 5.02 | 4.80 | 4.83 | 4.90 | 4.98 | 4.90 |
| Mastoid breadth | — | 11.00 | 10.93 | 11.22 | 11.11 | 11.12 | 11.07 | 11.06 | 11.08 | 11.06 | 10.77 | 10.92 | 10.98 | 10.68 |
| Anterior braincase breadth | — | 10.11 | 10.58 | 10.08 | 10.00 | 9.70 | 9.98 | 9.85 | 9.79 | 9.67 | 9.72 | 9.86 | 9.80 | 9.71 |
| Braincase height | — | 7.48 | 7.39 | 7.84 | 7.66 | 7.30 | 7.71 | 7.73 | 7.64 | 7.45 | 7.77 | 7.68 | 7.54 | 7.66 |
| Maxillary toothrow length | 11.00 | 10.75 | 10.98 | 10.18 | 10.93 | 10.79 | — | 10.07 | 10.18 | 10.89 | 10.71 | 10.72 | 10.89 | 10.54 |
| M3 breadth | — | 4.60 | 4.44 | 4.48 | 4.40 | 4.77 | — | 4.40 | 4.63 | 4.11 | 4.52 | 4.27 | 4.43 | 4.10 |
| Greatest breadth across the canines | — | 3.15 | 3.18 | 2.98 | 3.28 | 3.19 | 3.11 | 3.32 | 3.21 | 3.12 | 3.00 | 3.05 | 3.08 | 3.08 |
| Mandibular condylocanine length | — | 23.10 | 22.90 | 23.20 | 23.22 | 22.67 | 22.77 | 22.51 | 22.72 | 23.32 | 22.94 | 22.94 | 23.28 | 22.45 |
| Mandibular toothrow length | — | 11.89 | 11.8 | 1.77 | 3.03 | 1.64 | 2.74 | 2.74 | 2.50 | 2.48 | 2.63 | 2.19 | 1.91 | 2.52 |

while the single female recorded at Lomas de Granados (MUSM 44691) has a thin and delicate mandible.

**Potential distribution.** We found an optimum level of acceptance. The sensitivity value obtained was 0.989, which indicates that 98.9% of the localities observed would be included in the prediction (Fig. 3). The AUC value obtained in the final modeling was 0.975 (97.5%). The most important variables were: precipitation of coldest quarter (variable 19 of BioClim) with 27.1%, mean temperature of coldest quarter (variable 11 of BioClim) with 12.4%, and barren with 11.5%.

## Discussion

We found that *P. genovensium* is widely distributed in dry ecosystems of the western and eastern slopes of the Andes from Piura, Peru (Velazco et al. 2013) to Azapa Valley, Chile (Ossa et al. 2016), from sea level to 2,602 m elevation in Yura, Arequipa Department (Peru) (MNH 95). This record is 300 m higher than the highest reported by Griffiths and Gardner (2008).

The results of the potential distribution map and our new records from Cajamarca and Amazonas suggest that *P. genovensium* has a continuous distribution from western slopes to eastern Amazonian basin crossing the Depression of Huancabamba, and on the eastern Andes from the Marañón dry valley to the relicts of dry forests from Huánuco (Fig. 3). Additionally, the potential distribution map suggests its presence in the other eastern dry forests located on Huancabamba and the Mantaro and Apurímac rivers. Earlier, Koopman (1978) suggested that *P. genovensium* could have used the low passes of the northern Peruvian Andes to colonize the Amazon basin and settle in Huánuco.

On the other hand, the high prediction of occurrence of *P. genovensium* on Antofagasta, Chile, could be interpreted as a false positive, because this region is isolated from the current distribution of *P. genovensium* by the Atacama Desert. However, we do not rule out the presence of *P. genovensium* in the Atacama Desert because some cacti species occurring in this region are used as food by *P. genovensium* in Peru (Table 2), such as *Browningia candelaris* (Meyen) Britton and Rose, *Corryocactus brevistylus* (K. Schumann ex Vaupel) Britton and Rose, and other species of columnar cacti of *Echinopsis* and *Haageocereus* (Señoret and Acosta 2013, Miesen et al. 2015). Additional sampling along the potential distribution localities is needed to confirm the presence of *P. genovensium* in the Atacama Desert up to Antofagasta and in the eastern dry forests of Peru to better understand its distributional patterns.

According to the records, the habitat of *P. genovensium* comprises arid regions with xerophytic vegetation, presence of columnar cacti, low rainfall (30 to 180 mm on average per year), and temperatures relatively low (9–12 °C as the minimum annual average, 12–15 °C as the maximum annual average) (ONERN 1976, Baraybar 2004). Its restricted distribution to dry regions could also be related to its feeding specialization on nectar, pollen and fruits of columnar cacti that have pollination syndrome by zoochory, such as entomophilia, ornithophilia and chiropterophilia (Barthlott and Hunt 1993, Sahley 1995, Zamora et al. 2013), which also are distributed in dry regions. Several authors have found that the cactus flowers of *Armatocereus*, *Browningia*, *Echinopsis*, *Espostoa*, *Haageocereus*, *Neoraimondia,* and *Weberbauerocereus* have the chiropterophilia syndrome and are effectively pollinated by *P. genovensium* (Barthlott and Hunt 1993, Sahley 1995, Sahley and Baraybar 1996, Baraybar 2004; Table 2).

Throughout their distribution, *Platalina* co-occurs with other nectarivorous bats as *Lonchophylla hesperia*, *Anoura peruana* Tschudi, 1844, and *Glossophaga soricina valens* Miller 1913; however, information about their ecological relationships is limited. In Lomas de Granados, we recorded *P. genovensium* sharing a cave with *A. peruana*, which forms conglomerates of approximately 15 individuals occupying a different zone from that occupied by *P. genovensium*. Also, *P. genovensium* shared a cave with *Desmodus rotundus* (E. Geoffroy St.-Hilaire 1810) in Huánuco (Sanborn 1936). The organization in the colonies is also little known, but Malo de Molina et al. (2011) suggested that in Lima, the pregnant females and males are separated in a roost; however, in the caves of Lomas de Granados and Lomas de Atiquipa, *Platalina* was not separated by sex (D. Ruelas pers. obs.).

Currently, the populations of *P. genovensium* along their distributional range are threatened by vandalism because some populations are set on fire or their roosts are damaged or closed (Aragón and Aguirre 2007). The species is also affected by changes in the use of land, changes in plant coverage, and the intrusion of alien plant and animal species (Sahley and Baraybar 1996, Aragón and Aguirre 2007, Zelada et al. 2014). At present, several records are in fact historical records because the species no longer exist in the area. For example, the locality of El Agustino in Lima city recorded by Ortiz de la Puente (1951) in 1948 (MUSM 149) is currently an extensive urban area. Also, some caves reported at El Agustino are currently closed or destroyed (V. Pacheco, pers. comm.). A similar case has occurred with recently recorded localities as the Lomas of Cerro Escalera in La Libertad Department (Zelada et al. 2014). For that reason, the presence of *P. genovensium* in Ate, an urban area in the periphery of Lima city, was unexpected. Nonetheless, a possible adaptation to urban places is premature because only 1 individual was observed. Further studies are needed to confirm how frequently *P. genovensium* uses urban areas. Other studies recently performed in the Lima city have recorded only 2 nectarivorous bats, *Anoura peruana* and *Glossophaga soricina valens* (Mena and Williams de Castro 2002, Ruelas et al. 2016).

Here, we have reported some dental anomalies in the third molars of *P. genovensium* related to the oligodontia (missing teeth), which could be frequent in

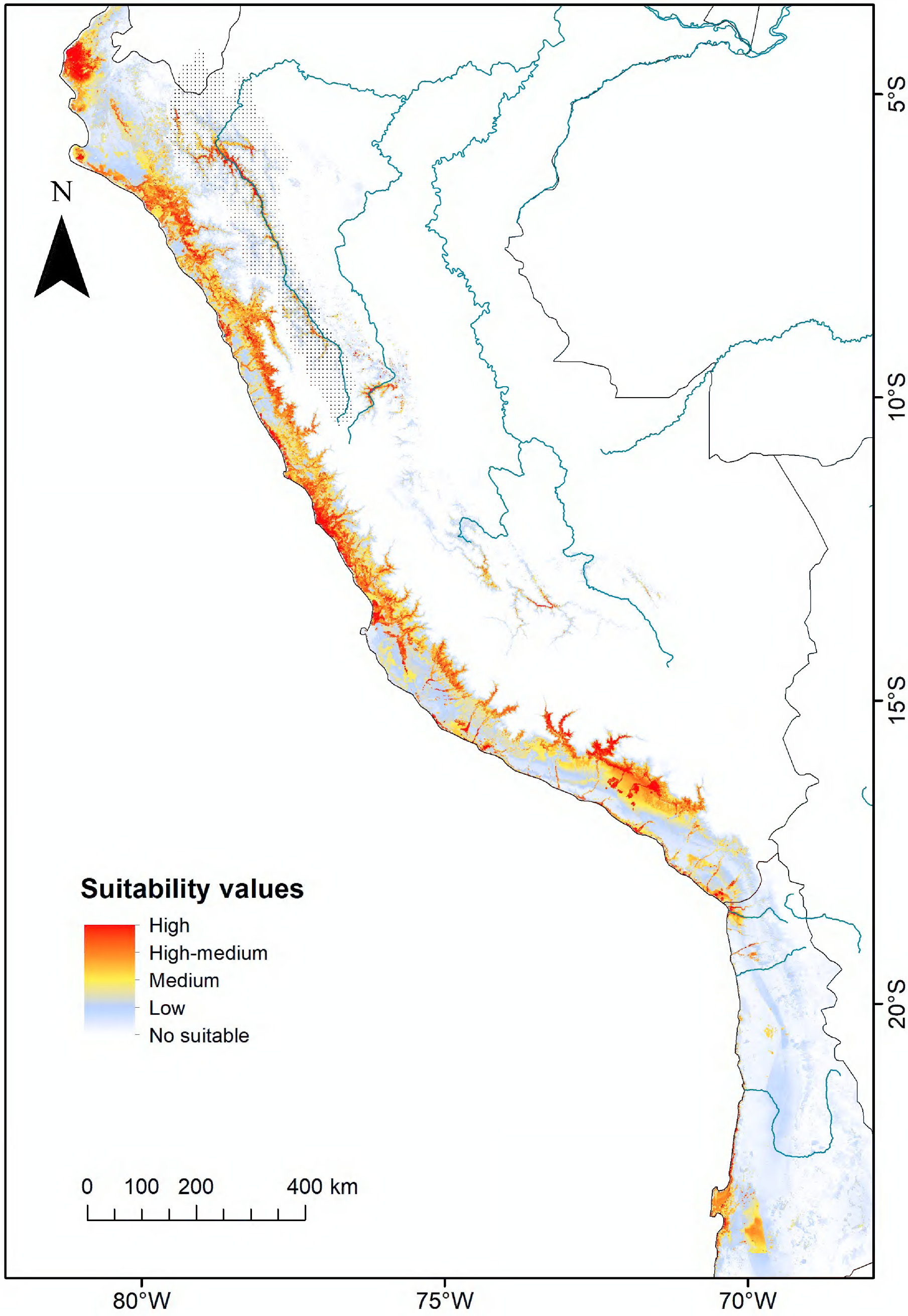


**Figure 3.** Map of potential distribution of *Platalina genovensium*. The Alto Marañón basin is shown with points. Color scale represents adequacy values of the prediction.

**Table 2.** Cactaceae with zoocoric pollination syndrome associated with *Platalina genovensium* habitat. Pollination syndrome: entomophilia (E), ornithophilia (O) and chiropterophilia (Q) following Barthlott and Hunt (1993) and Sahley and Baraybar (1996). Record localities: La Libertad Department: Cerro Campana (Ca) [Zelada et al. 2014]; Lima Department: Lomas de Lachay (La) [Cano et al. 1999]; Ica Department: Humay (Hu) [Zamora et al. 2013]; Arequipa department: Charcani, Batolito and Yarabamba (Ar) [Jiménez and Péfaur 1982, Sahley and Baraybar 1996, Baraybar 2004], Atiquipa (At) [Zamora 2005], Quechualla (Qu) [Ugarte and Salazar 1998]; Tacna Department: Sama (Sa) [Aragón and Aguirre 2007], Puite (Pu) [Aragón and Aguirre 2014]. Used by *Platalina*: flowers (fl), fruits (fr), nectar (n), pollen (p).

| Species | Name in the original record | Syndrome | Localities | Use |
|---|---|---|---|---|
| *Armatocereus matucanensis* | | | La, At[2] | |
| *Armatocereus procerus* | | Q | Hu | fr, p |
| *Browningia candelaris* | | Q | Hu, Ar | |
| *Cleistocactus acanthurus* | *Borzicactus* sp. | Q | La | |
| *Cleistocactus hystrix* | | O | Hu | |
| *Cleistocactus peculiaris* | | O | Hu | |
| *Corryocactus aureus* | *Erdisia meyenii* | | Ar | |
| *Corryocactus brevistylus* | | | Ar, Sa, Pu | |
| *Corryocactus brachypetalus* | | | At[2] | |
| *Cumulopuntia sphaerica* | *Tephrocactus sphaericus, T. dimorphus* | | Ar | |
| *Espostoa lanata* | | Q | Ca | |
| *Haageocereus acranthus* | *Haageocereus limensis* | O, Q | La | |
| *Haageocereus decumbens* | *Borzicactus decumbens* | Q | Ca, At[2] | |
| *Haageocereus pacalaensis* | *Haageocereus laredensis* | O, Q | Ca | |
| *Neoraimondia arequipensis* | *Cereus macrostibas*[1] | Q | Ca, Hu, Ar, Sa, Pu, At[2] | |
| *Oreocereus erectocylindricus* | *Arequipa erectocylindrica* | | Ar | |
| *Trichocereus chalaensis*[2] | *"Echinopsis gaymadi"*[3] | E, O, Q | At | fl, fr |
| *Weberbauerocereus weberbaueri* | | O, Q | Ar, At[2] | fr, n, p |
| *Weberbauerocereus rauhii* | | O, Q | Hu | fr, p |

[1] This name was only used by Ugarte and Salazar (1998). [2] Identified by A. Pauca com. pers. [3] This name was only used by Zamora (2005).

nectarivorous bats (Ramírez-Pulido and Müdespacher 1987), because these teeth are becoming less functional. Previously, Velazco et al. (2013) recorded 1 male specimen from Piura with only 2 upper molars on each side. Also, Velazco et al. (2013) found sexual dimorphism in the robustness of the mandibular rami, where the females have thin and more delicate mandibular rami than the males, although this trait was not quantified. However, our finding of a male specimen from Amazonas with a thin mandible suggests that the secondary sexual dimorphism hypothesis on the mandibular rami needs to be confirmed by a morphometric study.

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## Authors' Contributions

D. Ruelas designed the research, collected the specimens, analyzed the data, and drafted the article. V. Pacheco contributed to the collection of specimens, research design, and critically reviewed the draft.

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# Appendix

**Specimens used for comparisons.** Sex: female (f), male (m).

*Platalina genovensium* ($n$ = 10): PERU: **Arequipa**: Arequipa, Tiabaya, Batolito Caldera, 1 m (MUSM 12900); Arequipa, Yura, 2f 2m (MUSM 46318, 46319, 46437, 46438). **Lima**: Lima, Cerro Agustino, m (MUSM 149). **Ica**, Pisco, Mina Bolívar, punto 7, 1f 3m (MUSM 26150, 26152-26155).